

DRAFT

**PER- and POLYFLUORALKYL SUBSTANCES FIELD SAMPLING PLAN  
OPERABLE UNIT THREE**

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**W.R. GRACE SUPERFUND SITE  
ACTON, MASSACHUSETTS**

PREPARED FOR

W.R. GRACE & CO. - CONN  
7500 GRACE DRIVE  
COLUMBIA, MARYLAND 21044

PREPARED BY

TETRA TECH, INC.  
3 LAN DRIVE, SUITE 100  
WESTFORD, MASSACHUSETTS 01886  
(978) 303-8531



**TETRA TECH**

JUNE 14, 2019

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**Figure 1 - W.R. Grace Site Location**

**Figure 2 - Potential Source Areas**

**Figure 3 - Proposed PPFAS Sampling Locations**

Attachment A - Standard Operating Procedures

### ACRONYMS

AFFF	Aqueous film forming foam
ARS	Aquifer Restoration System
ATSDR	Agency for Toxic Substances and Disease Registry
FSP	Field Sampling Plan
Grace	W.R. Grace & Co. – Conn.
IDW	Investigation Derived Waste
ISCR	Initial Site Characterization Report (HIS GeoTrans, 1998)
MassDEP	Massachusetts Department of Environmental Protection
OU	Operable Unit
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PPT	Parts Per Trillion
POP	Project Operation Plan
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
SOP	Standard Operating Procedures
Site	W.R. Grace & Co. – Conn. Superfund Site
SMP	Site Management Plan
SOW	Statement of Work
US EPA	United States Environmental Protection Agency
VDC	1,1-dichloroethene

## 1 INTRODUCTION

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This Field Sampling Plan (FSP) addresses groundwater sampling for Per- and Polyfluorinated Substances (PFAS) analysis at the W. R. Grace & Co. – Conn. (Grace) Acton Superfund Site (the Site). This plan incorporates by reference existing Project Operations Plan (POP) documents from the original POP (March 10, 2000) and the amended POP submitted on February 1, 2007. The FSP is prepared to address comment 10 in USEPA’s March 14, 2019 letter titled “EPA comments on the 2018 Operable Unit Three Monitoring Report (the “Report”) and Recommended Modifications to 2019 Annual Sampling Round, W.R. Grace Superfund Site, Acton, Massachusetts.”

The Grace Site is located in Acton and Concord, Massachusetts, Figure 1 is a map showing the Site and the surrounding area. The Grace property is bordered by residential property on the northwest, east, and west, and industrial properties to the south and northeast. Sinking Pond, a kettle pond, is located in the southwestern portion of the property, and Turtle and Muskrat Ponds, which occupy former gravel pits, are located south of the property. Fort Pond Brook bounds the property to the northwest and the Town of Concord solar array parcel bounds the property to the southeast. The Assabet Wellfield, which supplies water for a portion of the Town of Acton, is located southwest of the property. The School Street Wellfield, which also supplies a portion of the water for the Town of Acton, is located northeast of the property.

The Site is a former chemical manufacturing facility, used for industrial purposes for over one hundred years. American Cyanamid Company and the Dewey & Almy Chemical Company (D&A) were former occupants of the Site. American Cyanamid manufactured explosives, and D&A produced synthetic rubber container sealant products, latex products, plasticizers, and resins. W. R. Grace acquired the property in 1954, and chemical operations were continued at the Site. Operations at the W. R. Grace facility included the production of materials used to make concrete and organic chemicals, container sealing compounds, latex products, and paper and plastic battery separators. Wastewater and solid industrial wastes from these operations were disposed of in several unlined lagoons (the Primary Lagoon, Secondary Lagoon, North Lagoon, and Emergency Lagoon), and were buried in or placed

onto an on-site Industrial Landfill and several other waste disposal area (see Figure 2). These other waste disposal areas include the Battery Separator Area (lagoon and chip pile), the Tank Car Area, and the Boiler Lagoon which was located between the Battery Separator and Tank Car Areas. Periodically, sludge from the Primary Lagoon was dredged, dried along the banks, and trucked to the landfill for disposal. In addition, the by-products of some chemical processes were disposed of in the Blowdown Pit. Discharge to all lagoons and the Battery Separator Area ceased in 1980. The production of organic chemicals was discontinued in 1982. A small distribution center for concrete additives was moved to another location in September 1996. A second plant for the manufacture of battery separators, known as the Daramic facility, was constructed in 1979, but operations there ceased in 1991. All buildings, with the exception of those associated with the remedial actions, have been demolished and the sludge/soil and sediment have since been remediated (Operable Unit 1). (USEPA, September 23, 2014 Five-Year Review Report).

## 2 PROJECT ORGANIZATION

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Tetra Tech will be responsible for performing the sampling and reporting, and coordinating with the analytical laboratory, Test America (Eurofins TestAmerica). Contact information is provided below:

<b>Project Coordinator</b> <b>Contractor: Tetra Tech, Inc.</b> Project Manager: Edward Dolan 3 Lan Drive, Suite 100 Westford, MA 01886 Ph: (978) 303-8531 Fax: (978) 952-0122 E-Mail: ed.dolan@tetrattech.com
<b>Analytical Laboratory</b> <b>Contractor: Test America (Eurofins TestAmerica)</b> Project Manager: Becky Mason 501 Southampton Road, Unit C Buffalo, NY 01085 Ph: (413) 642-2617 E-Mail: becky.mason@testamericainc.com

Sampling activities will be coordinated and based out of Tetra Tech's Westford, MA office. Samples will be shipped from Tetra Tech's office to the Eurofins TestAmerica laboratory in Sacramento, CA.

All analytical data will continue to be reported in the Annual Monitoring Reports (AMRs). The annual reports will be sent directly to the USEPA and the MADEP contacts listed below:

Mr. Christopher Smith Waste Management Division U.S. Environmental Protection Agency Region 1 5 Post Office Square Mail Code OSRR07-4 Boston, MA 02109-3912	Ms. Jennifer McWeeney Bureau of Waste Site Cleanup Massachusetts Department of Environmental Protection One Winter Street, 7 <sup>th</sup> Floor Boston, MA 02108
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### **3 DATA MANAGEMENT**

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To facilitate consistent and reliable transfer of data, the data management system already established for the Site will be continued. The data management software is compatible with computer equipment available to the US EPA and MassDEP.

Data collected and reported during the implementation of this sampling event will include:

- Laboratory analytical results;
- Well development forms;
- Sampling forms;
- Water level data; and,
- Field notes

Standard Operating Procedures (SOP) for collection of these types of data are presented in Attachment A of this FSP.

Water level and water quality data will continue to be added to the existing Site database in Microsoft Access, which is a relational database management system.

Analytical data will be delivered in both hard copy and in an electronically readable format compatible with the database management system. Following any required validation data will be added to the existing Site database. Data that do not require validation will be added to the existing Site database upon receipt from the analytical laboratory.

## 4 MONITORING WELL SAMPLING

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Perfluoroalkyl and Polyfluoroalkyl Substances (collectively known as PFAS) are emerging contaminants under study at federal and state regulated sites. PFAS have been used since the 1940s as manufacturer-applied oil and water repellants on products such as clothing, upholstery, paper and carpets and in making fluoropolymers for non-stick cookware. They are found in textiles and leather products, mist suppressants for metal plating, materials used in the photography industry, photolithography, semi-conductors, paper and packaging, coatings, cleaning products, pesticides, and cosmetics. They have been used in well-known consumer products including Teflon, StainMaster, Scotchgard, and GoreTex. In the 1960s, aqueous film-forming foam (AFFF) containing PFASs was developed for fighting flammable liquid fires, particularly petroleum-fueled (Class B) fires (ATSDR, 2009).

PFAS are persistent in the environment and are present in or on some materials commonly used in environmental sampling (e.g., Teflon tubing, waterproof logbooks, and GoreTex field clothing).

### 4.1 SAMPLING NETWORK RATIONALE

The goal of the proposed sampling for PFAS analysis is to determine if PFAS are present in groundwater at the site. The sampling network has been developed to target areas at or hydraulically downgradient from known historic Site disposal areas (“Source” sampling). PFAS compounds tend to be located at media interfaces (e.g., the capillary fringe or water table). Therefore, shallow wells are targeted for sampling. The goal of this sampling plan is not to completely define the nature and extent of any PFAS at the Site, but rather to determine whether PFAS are present at the Site.

The EPA’s Draft Interim Recommendations to Address Groundwater Contaminated with PFOA and PFOS (EPA, April 2019), recommends a Regional Screening Level (RSL) of 40 ppt. Should the sum of PFAS exceed the EPA’s draft RSL, a second phase of sampling will be initiated. Depending on the results an appropriate subset of the second phase of sampling (“Sentinel” sampling) will focus on areas upgradient from public supply wells and



groundwater discharge areas. The PFAS sampling SOP will discuss analytical methods and DQOs. The “Source” and “Sentinel” well sampling rationale is presented below.

#### 4.1.1 SOURCE SAMPLING NETWORK

As defined in the 2001 Remedial Investigation, the source areas at the site are:

- Former Primary Lagoon;
- Former Secondary Lagoon;
- Former Emergency Lagoon;
- Capped Landfill Area;
- Former North Lagoon;
- Former Boiler Lagoon;
- Former Battery Separator Area;
- Former Tank Car Area;
- Former Blowdown Pit; and,
- The former manufacturing complex, situated in an area between the former Battery Separator, the Former North, Primary, Emergency Lagoons and the Former Blowdown Pit.

The following table presents the source location and the rationale for sampling each location for PFAS:

Source Area	Rationale
Former Primary Lagoon	Received wastewater directly from the former plant
Former Secondary Lagoon	Received supernatant from the Primary Lagoon
Former Emergency Lagoon	Received wastewater directly from the former plant, when the Primary Lagoon was being dredged
Capped landfill Area	Wastes include latex, synthetic rubbers, lagoon sludge, battery separators, paper, drums of rubber, oil and sealing compounds
Former North Lagoon	Received process wastewater similar to those discharged to the Primary Lagoon, and washing waste from the Tank Car Area
Former Boiler Lagoon	Received annual flushings of phenolic resins from two resin storage tanks
Former Battery Separator Area	Three interconnected lagoons received drainage from floor drains in the former Cellulose building, phenolic resin

	flushings, and likely some phenolic resin-impregnated paper waste from nearby chip piles
Former Tank Car Area	Residues from raw materials transported to the plant by rail
Former Blowdown Pit	Material placed in the pit included latex polymer residues from the venting of reactor vessels
Former Active Manufacturing Complex	Use and manufacture of chemicals and materials as described in the operational history above

The following table presents the Source Area and any associated proposed monitoring locations. Figure 3 shows the proposed sampling locations (green boxes around the well/well cluster).

Source Area	Well Name	Well Cluster Map ID	Notes
Former Primary Lagoon	OSA-13A	OSA-13	
Former Secondary Lagoon	LF-11CR	LF-11R	
Former Emergency Lagoon	OSA-14A	OSA-14	
Capped landfill Area	B-08D, LF-05C, LF-10C	B-08, LF-05, LF-10,	
Former North Lagoon	OSA-07A	OSA-07	
Former Boiler Lagoon	OSA-23A	OSA-23	
Former Battery Separator Area	OSA-21	OSA-21	
Former Tank Car Area	OSA-10A	OSA-10	
Former Blowdown Pit	BD-2, OSA-01A	BD-2, OSA-01	Area is in a hydraulic stagnation zone so two wells are proposed
Former Active Manufacturing Complex	No separate sampling is proposed, because the wells proposed above include wells from Source Areas surrounding the former manufacturing complex		

#### 4.1.2 SENTINEL WELL SAMPLING NETWORK

As described above, should the analytical results from the initial sampling warrant additional sampling, then an appropriate group of wells from the following Sentinel Well list will be sampled to provide an indication of presence/absence at distal portions of the site and

near surface water. The below table presents the proposed Sentinel Well sampling network and rationale. The locations of the proposed Sentinel Wells are shown on Figure 3 (blue boxes around the well/well cluster).

<b>Sentinel Well Location</b>	<b>Well</b>	<b>Well Cluster Map ID</b>
Southwest Area, distal location, upgradient of Assabet Well Field	73-3 (shallow unconsolidated)	73-3
Edge of Southeast Landfill capture zone	LF-06C (shallow unconsolidated)	LF-06
Downgradient of Capped Industrial Landfill, proximal to Assabet River	AR-20A (shallow unconsolidated), AR-20 (deep unconsolidated)	AR-20
Adjacent to Assabet River	LF-13B (shallow unconsolidated), LF-13A (deep unconsolidated)	LF-13
Assabet River Area, distal to source areas	AR-14P (shallow unconsolidated)	AR-14
Northeast Area (School Street Well Field)	AR-31D (deep unconsolidated)	AR-31

## 4.2 ANALYTICAL METHOD AND ANALYTE LIST

The Sacramento, CA laboratory for Test America (Eurofins TestAmerica) will use a method that is an enhanced method 537.1 and would be compliant with the pending EPA method (as currently planned). This method is “537M Manual SPE” which is applicable for non-potable water (groundwater and surface samples) and includes isotope dilution to filter out potential interferences to improve measurement accuracy. The method will report the 14 analytes referenced in the MADEP June 19, 2018 Fact Sheet, as well as the additional 10 analytes that are listed in the pending USEPA “non-potable” method (EPA Method 8328). The table below presents the analyte list for PFAS. A Quality Assurance Project Plan (QAPP) will be submitted under a separate cover.

<b>PFAS Analyte List Method 537M Manual SPE</b>
Perfluorobutanoic acid (PFBA)
Perfluoropentanoic acid (PFPeA)
Perfluorohexanoic acid (PFHxA)
Perfluoroheptanoic acid (PFHpA)
Perfluorooctanoic acid (PFOA)
Perfluorononanoic acid (PFNA)
Perfluorodecanoic acid (PFDA)
Perfluoroundecanoic acid (PFUnA)
Perfluorododecanoic acid (PFDoA)
Perfluorotridecanoic acid (PFTriA)
Perfluorotetradecanoic acid (PFTeA)
Perfluorobutanesulfonic acid (PFBS)
Perfluoropentanesulfonic acid (PFPeS)
Perfluorohexanesulfonic acid (PFHxS)
Perfluoroheptanesulfonic Acid (PFHpS)
Perfluorooctanesulfonic acid (PFOS)
Perfluorononanesulfonic acid (PFNS)
Perfluorodecanesulfonic acid (PFDS)
Perfluorooctanesulfonamide (FOSA)
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)
4:2 FTS
6:2 FTS
8:2 FTS

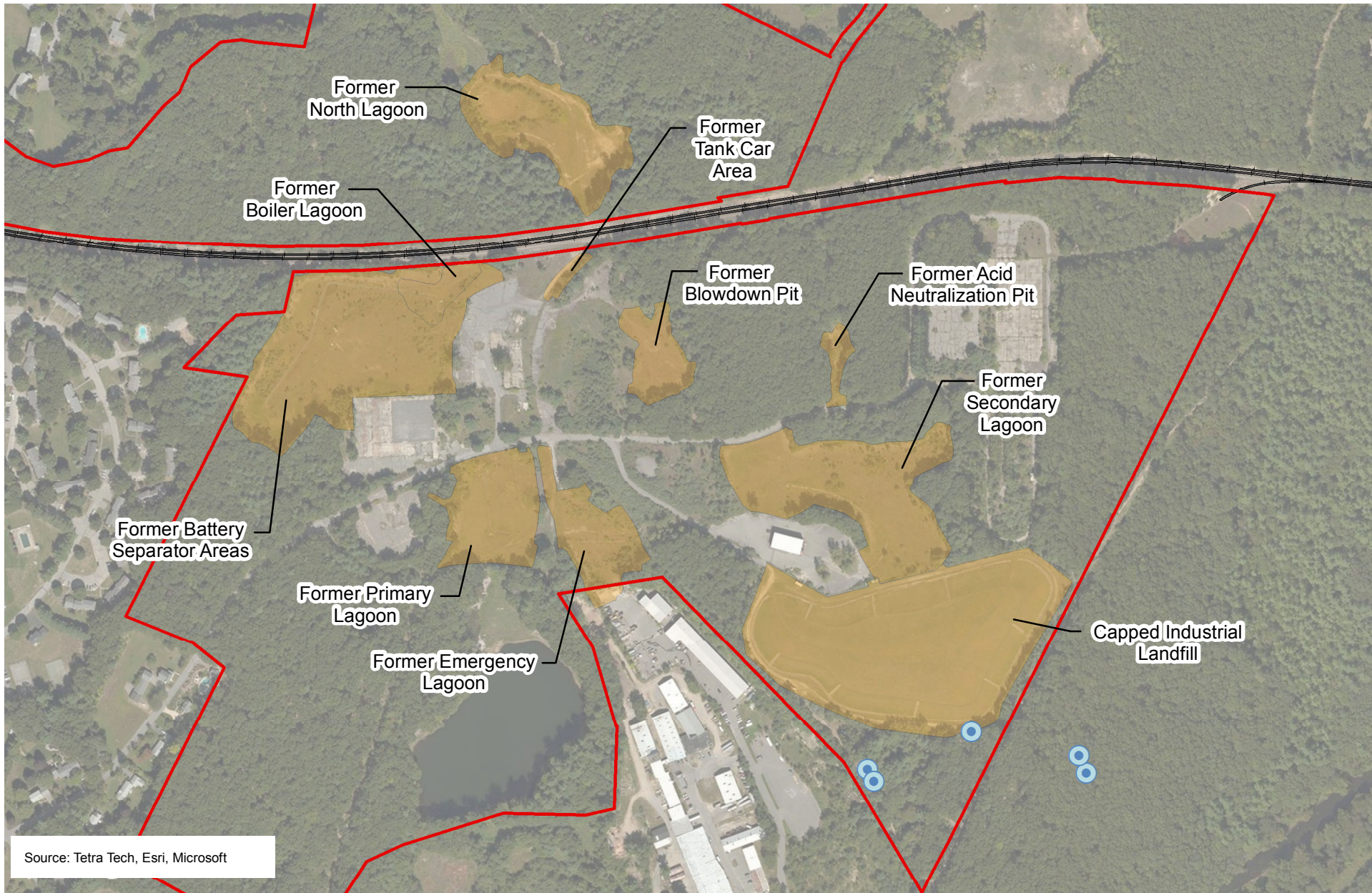
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## FIGURES



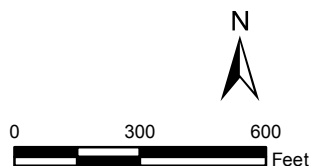






## Legend

- Grace Property Boundary (Approximate)
- Source Area
- Grace Extraction Well



TITLE:

**Potential Source Areas**

LOCATION:

W.R. Grace, Acton, Massachusetts



**TETRA TECH**

CHECKED:

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DRAFTED:

JML

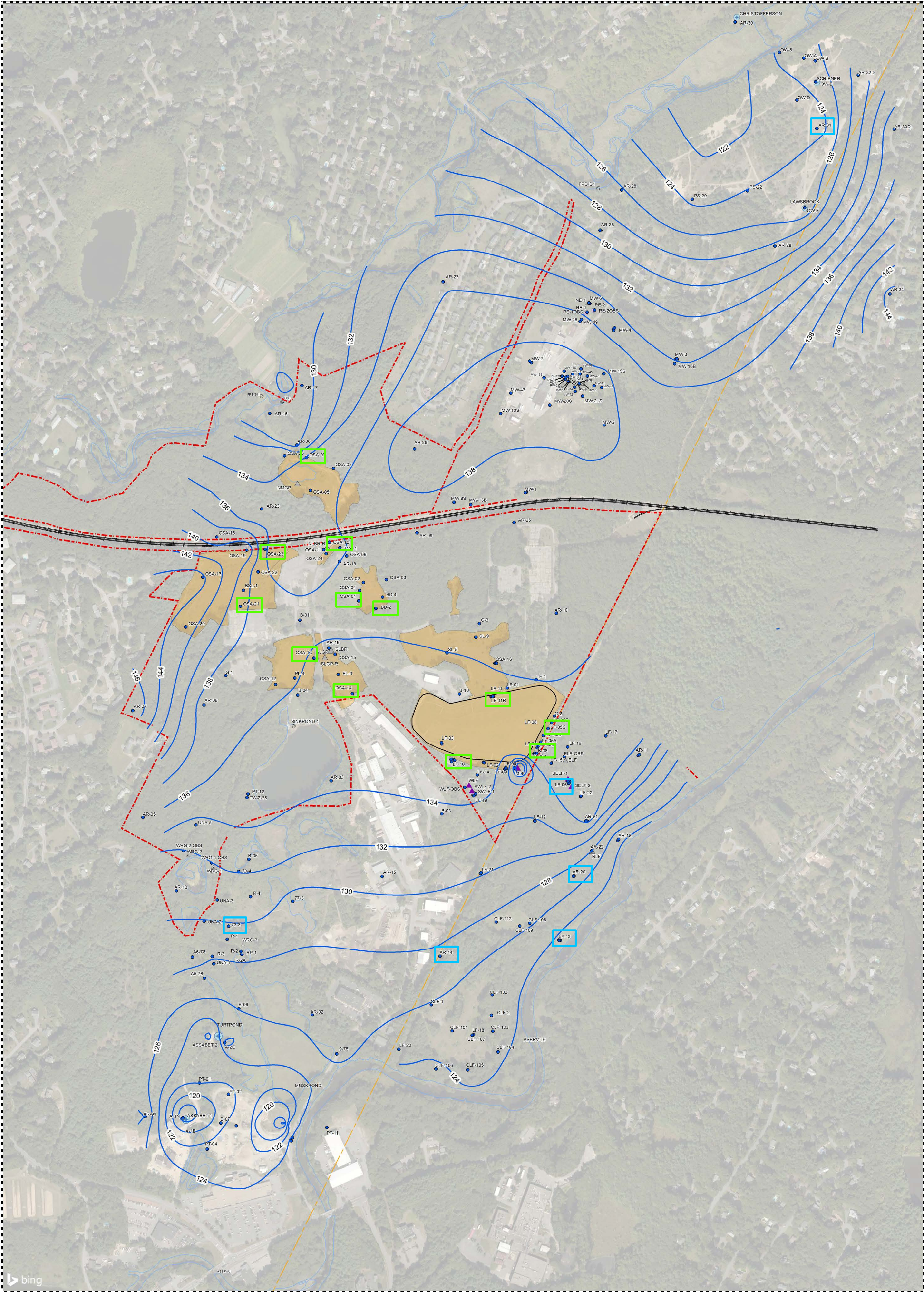
DATE:

03/20/19

FIGURE:

**2**





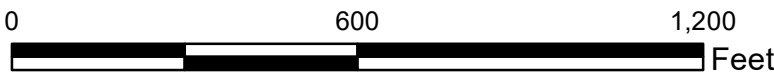
Explanation

Grace Locations

- Monitoring Well Cluster
- Public Water Supply Well
- Former Recovery Well
- Recovery Well
- Decomissioned Recovery Well
- Non-Grace Recovery Well
- Former Reinjection Well

- Water Body
- Town Boundary
- Railroad
- Grace Property Boundary
- Proposed PFAS Sampling Location Phase 1
- Proposed PFAS Sampling Location Phase 2
- Contour (2018)

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TITLE: Proposed PFAS Sampling Locations		
LOCATION: W.R. Grace, Acton, Massachusetts		
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**Attachment A**  
**Standard Operating Procedures**

OPERABLE UNIT THREE  
ACTON, MASSACHUSETTS

## **STANDARD OPERATING PROCEDURE**

### **1 WATER LEVEL MEASUREMENT**

# **1 WATER LEVEL MEASUREMENT**

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## **1.1 INTRODUCTION**

Water-level measurements will be made using an electronic water-level sensor or a steel tape measure. Prior to gauging the well, the current year's field sampling list (Annual Monitoring Report's cover letter Table 1. Summary of Proposed 20XX Annual Groundwater Sampling) should be reviewed to determine if the well is to be sampled for PFAS. If the well is NOT to be sampled for PFAS, then decontamination procedures should follow those in 1.5.1. If the well is to be sampled for PFAS, then decontamination procedures should follow those in 1.5.2.

## **1.2 AIR QUALITY/SECURITY**

Unlock and open the monitoring well. Monitor the headspace in the breathing zone above the well using the flame and/or photoionization detector. Record the readings on the proper air monitoring form, and note the condition of the protective casing and lock on any project-specific forms and/or field books. VOC measurements will be made at all monitoring wells during the initial sampling round and will continue for any wells with sustained readings at or above the action levels outlined in the Health and Safety Plan.

## **1.3 MEASURING POINT**

Check for the measuring point (MP) of the well. The MP location should be clearly marked on the riser, outer casing or guard pipe. If no mark can be determined the MP shall be assumed to be the highest point on the riser or the guard pipe if the riser is beyond the reach of the measurer. A mark will be made on the well for future measurements and the date of the marking will be recorded on the sampling form and in the field log book. An accurate description of this point must be entered with the water level.

## **1.4 MEASUREMENT**

To obtain a water-level measurement, lower a clean water-level probe into the monitoring well. Care must be taken to assure that the measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. The sensor should be lowered into the well until the indicator light and/or audible tone is triggered. At this point repeated raising and lowering of the sensor will allow convergence on the exact water-level in the well.

Measurements should be read to the hundredth of a foot and recorded on the project-specific forms and/or field books. This process should be repeated as a check of the accuracy of the initial reading. In the event that an electronic probe fails or is unavailable, water-level measurements can be obtained using a clean calibrated steel measuring tape. Blue carpenters chalk is applied to the lower 3 feet of the tape. When a calibrated tape is lowered into a well a weight, attached to the tape and hollowed out on the bottom, will deliver an audible "plop" when it contacts the water surface. After the plop is heard the tape is then lowered approximately 1 foot into the water. The depth held is recorded. The tape is then removed from the well and the wet mark on the tape is recorded. The depth to water is determined by subtracting the measurement of the wet mark from that of the held mark. Once again, this process should be repeated to check the accuracy of the initial reading.

## **1.5 DECONTAMINATION**

### **1.5.1 Wells That Will Not Be Sampled for PFAS**

The measurement device shall be decontaminated immediately after use with an isopropanol-soaked towel or direct application of the isopropanol followed by a rinse with distilled water. Generally, only that portion of the tape which enters below the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground.

### **1.5.2 Wells That Will Be Sampled for PFAS**

The measurement device shall be decontaminated immediately after use with an isopropanol-soaked towel or direct application of the isopropanol followed by a rinse with

distilled water. The final rinse should be conducted using PFAS-Free water provided by the analytical laboratory. Generally, only that portion of the tape which enters below the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground.

## **1.6 DOCUMENTATION**

All observations are to be documented in a water-resistant field book and on the appropriate water level forms. An exception to this is if the well in question is to be sampled for PFAS. In this case, water-resistant field books or notebooks and plastic clipboards should not be used; non-water-resistant notebooks or loose-leaf paper is acceptable, as are metal clipboards. In addition, ball-point pens instead of markers should be used. The bottom of each page is to be signed by the individual(s) taking the notes.

## **STANDARD OPERATING PROCEDURE**

### **4 GROUNDWATER SAMPLING**

## 4 GROUNDWATER SAMPLING FOR PFAS

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### 4.1 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide information on the collection of groundwater samples that will be analyzed for Per- and Polyfluoroalkyl Substances (PFAS). Three types of monitoring wells exist at the Acton Site, conventional monitoring wells, Solinst wells, and Barcad wells.

Low flow groundwater sampling will be performed at the conventional monitoring wells. Low flow groundwater sampling aims to collect groundwater samples that are "representative" of mobile organic in the vicinity of the open well interval, at near natural flow conditions. The minimum stress procedure emphasizes negligible water level drawdown and low pumping rates in order to collect samples with minimal alterations in in-situ water chemistry. This procedure is designed primarily to be used in wells with a saturated screen, or open interval length of ten feet or less. The procedure is flexible for various well construction and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than five Nephelometric Turbidity Unit (NTU) and to achieve a water level drawdown of less than 0.3 feet during purging and sampling. If these goals cannot be achieved, sample collection can take place provided the remaining criteria in this procedure are met. If a low flow sample cannot be obtained, a sample will be collected with a bailer or tubing with a Waterra foot valve.

The Barcad wells will be sampled using the nitrogen gas purge method recommended by the manufacturer.

Solinst multi-level wells can be sampled using low flow procedures similar to conventional monitoring wells.

### 4.2 EQUIPMENT

- Low Flow Sampling or Purge & Sample
  - Certified PFAS free bladder pump (e.g. QED Sample Pro®)
  - Tubing – High-density polyethylene (HDPE)
  - HDPE Bailer
  - PFAS-free Waterra foot valve with HDPE tubing

- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples
  - Water level measuring device - 0.01 foot accuracy. (Electronic devices are preferred for tracking water level drawdown during all pumping operations.)
  - Indicator parameter monitoring instruments - pH (EPA Methods 150.1 or 9040), turbidity (EPA Method 180.1), specific conductance (EPA Methods 120.1 or 9050), and temperature (EPA Method 170.1)
  - Optional Indicators - ORP and dissolved oxygen (EPA Method 360.1)
  - Flow-through cell for measurement of indicator parameters
  - Standards to perform field calibration of instruments
- Barcad Sampling
  - Ultra High Purity Nitrogen Gas
  - Inert Gas Regulator
  - Nitrogen high pressure air lines
  - Barcad Actuator
  - Sample tubing - HDPE tubing
- Flow measurement supplies (e.g., graduated cylinder and stop watch)
- Decontamination supplies including distilled water, PFAS-free water, and Liquinox
- Field forms must be plain paper – waterproof or water-resistant paper is to be avoided
- Ball-point pens
- Masonite or aluminum clipboards
- Sample bottles
  - For PFAS samples for drinking water, polypropylene sample bottles with polypropylene caps are to be used.
  - For all other PFAS samples, use HDPE bottles with unlined plastic screw caps.
- Sample preservation supplies (as required by the analytical methods)
- Sample tags or labels
- Well construction data, location map, field data from last sampling event
- Field Sampling Plan
- PID or FID instrument for measuring VOCs
- Special Considerations for PFAS sampling and handling



- Non-waterproof loose-leaf paper or notebooks are acceptable. Avoid using waterproof field books or paper during sampling activities. Do not use plastic clipboards, binders, or spiral hard-cover notebooks that may be coated, use Masonite or aluminum clipboards instead.
- Avoid using Post-it notes or similar removable notes during sample handling or mobilization/demobilization activities.
- Use ballpoint pens or pencils for note taking and sample bottle labeling. Avoid using Sharpies or similar indelible markers.
- Avoid the use of aluminum foil.
- Wear clothing that has been washed at least six times without fabric softener to remove possible stain-resistant coatings. Clothing made of natural fibers such as cotton is preferred to other fabrics. Protective clothing must be washed in accordance with manufacturer recommendations to ensure that the protective properties necessary to control safety hazards (e.g., fire-retardant clothing) are not compromised.
- Avoid unnecessary contact with upholstery in vehicles because many such fabrics may be treated with stain-resistant materials that could contain PFAS. Typically, rental vehicles are newer and more likely to pose a contamination risk to samples. Well-washed towels or rags may be placed on the seats to prevent contact with car seats and other materials that could transfer PFAS to clothing worn by samplers. If practical, cover clothing and skin that has been in contact with such upholstery with non-fluorinated clothing.
- During wet weather, use rain gear made from polyurethane or wax-coated materials.
- Avoid wearing water-resistant (e.g., Gore-Tex or similar material) clothing or footwear (e.g., boots) immediately prior to or during sample collection and management.
- Avoid wearing coated Tyvek or similar coated PPE suits.
- Wear un-powdered nitrile gloves at all times while collecting and handling samples, and change gloves often. Anecdotal evidence indicates that changing gloves is one of the most effective methods of reducing or eliminating sample contamination potential; therefore, change to a new pair of gloves prior to collecting each sample.

- Avoid wearing cosmetics, shampoos, hair conditioners, moisturizers, hand cream, or other similar personal care products on the day of sampling.
- As necessary, use sunscreens and insect repellants that are made with 100-percent natural ingredients and that the Air Force Civil Engineer Center has identified as acceptable for use. These products must be used in accordance with manufacturer recommendations and in combination with controls in the project-specific HASP, APP, and corporate health and safety policies. Multiple applications of these products per work shift may be required to ensure their effectiveness.
- Avoid using Blue Ice or similar items to cool samples and avoid placing such items in sample coolers for shipping. Use commercially available (e.g., from convenience stores or supermarkets) double-bagged ice instead.
- Wash hands thoroughly before sampling and after handling fast food, carryout food, snacks, or other items that may contain PFAS. Do not carry pre-packaged food items such as candy bars or microwave popcorn into sampling areas.
- Minimize exposure of samples to light. This can be done by placing the collected samples into a cooler (with ice) and closing the cooler lid.
- If in doubt about a particular product or item that comes into contact with environmental media to be sampled or is near to sampling operations, consider collecting and analyzing a rinsate blank using laboratory-supplied PFAS-free water to test the item for contamination potential. Consult the Tetra Tech PM in these cases to verify whether collection of additional blanks is warranted.
- Support personnel that are within 3 meters of the sample processing area are considered subject to the same restrictions related to precautionary measures for clothing and food as applied to sampling personnel.

## **4.3 PURGING AND SAMPLING PROCEDURE**

### **4.3.1 INITIAL PROCEDURES**

Prior to collecting the sample, the following steps will be performed:

- Check well for damage or evidence of tampering. Record pertinent observations
- Remove well cap and immediately measure VOCs in the breathing zone above the well with a PID or FID instrument and record the reading in the field logbook
- If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one
- For conventional wells, measure and record the depth to water (to 0.01 feet) in the well to be sampled before any purging begins. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well

### **4.3.2 LOW FLOW SAMPLING**

#### **4.3.2.1 PURGING**

Use a submersible pump to purge and sample monitoring wells which have a one-and-a-half-inch or greater well casing diameter.

Measure and record the water level again just prior to placing the pump in the well.

Lower pump, safety cable, tubing, and electrical lines slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible keep the pump intake at least two feet above the bottom of the well to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbid-free water samples may be difficult if there are three feet or less of standing water in the well.

When starting the pump, slowly increase the pump speed until discharge begins. Check water level. Adjust pump speed until there is little or no water level drawdown. The target drawdown should be less than 0.3 feet and it should stabilize. If the target of less than 0.3 feet

cannot be achieved or maintained, the sampling is acceptable if remaining criteria in the procedure are met. Subsequent sampling rounds will probably have intake settings and extraction rates that are comparable to those used in the initial sampling rounds.

Monitor water level and pumping rate every three to five minutes (or as appropriate) during purging. Record pumping rate adjustments and depths to water. Pumping rates should be reduced, as needed, to the minimum capabilities of the pump (e.g., 0.1-0.2 l/min.) to ensure stabilization of indicator parameters. Adjustments are best made in the first 15 minutes of pumping in order to help minimize purging time. During initial pump start-up, drawdown may exceed the 0.3 feet target and then recover as pump flow adjustments are made (minimum purge volume calculations should utilize stabilized drawdown values, not the initial drawdown). If the recharge rate of the well is less than the minimum capability of the pump do not allow the water level to fall to the intake level. If the non-pumping water level is above the screen, avoid lowering the water level into the screen. Shut off the pump if either of the above is about to occur and allow the water level to recover. Repeat the process until field indicator parameters stabilize and the minimum purge volume is removed. The minimum purge volume with negligible drawdown (0.3 feet or less) is the volume of the drawdown plus the volume of the tubing. After the minimum purge volume is attained (and field parameters have stabilized) begin sampling. For low yield wells, commence sampling as soon as the well has recovered sufficiently to collect the appropriate volume for all anticipated samples.

#### **43.2.2 FIELD PARAMETER STABILIZATION AND SAMPLE COLLECTION**

During well purging, monitor field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). Purging is complete and sampling may begin when all field indicator parameters have stabilized as follows for three consecutive readings taken at three- to five-minute intervals:

- turbidity: within 10% for values >1 NTU
- DO: within 10%
- specific conductance: within 3%
- temperature: within 3%
- pH:  $\pm 0.1$  unit
- ORP:  $\pm 10$  millivolts

If the parameters have stabilized, but turbidity remains above the five NTU goal, decrease pump flow rate, and continue measurement of parameters every three to five minutes. If the pumping rate cannot be decreased any further and stabilized turbidity values remain above the five NTU goal, record this information and collect the samples. If the parameters have not stabilized after three screen volumes have been removed or four hours of purging have occurred, record this information and collect the samples. Measurements of the field parameters should be obtained using a flow-through cell (preferred method) or taken in a clean container (a glass beaker is suitable). Measurements for dissolved oxygen and ORP must be obtained using a flow-through cell in a manner in which the sample is not exposed to air prior to the measurement. Prior to collecting the samples for laboratory analyses, the flow-through cell must be disconnected. Note, turbidity, temperature, specific conductance, and pH measurements must be recorded. If these measurements are missing, the resulting sampling data may not be acceptable. If the optional indicator parameters, dissolved oxygen, and ORP are measured, they must be recorded.

Label each sample as collected. Samples will be placed into an ice cooler for delivery to the laboratory. After collection of the samples, the pump tubing may either be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth.

Secure the well.

### **4.3.3 BARCAD SAMPLING**

Prior to sampling Barcad devices the depth to water will be determined from a proximal piezometer or monitoring well. The water column for each device will be determined based on the depth to water and the completion depth of the Barcad device. Once the water column length is determined the pressure for the nitrogen drive will be set (.5 psi / ft.) and purge volumes will be determined.

The pressure actuator will be connected to the dedicated Barcad tubing at the well head. The actuator allows pressure to be applied to the drive tube which in turn drives the water column

to the surface for collection via the inner sample riser tube. Ultra-high purity nitrogen gas will be used for the drive gas in all Barcad sampling devices. The configuration of the Barcad system allows for the complete evacuation of the sampling device, so that the recharge water to the system is fresh formation water. The Barcad devices will be flushed a minimum of three times prior to sampling the given interval to purge the device of any stagnant water. Ample time between drive cycles shall be allowed for recovery of the sampling interval. The purge volume and time from each cycle shall be recorded on the Nitrogen Drive Sample sheet. Full recovery from the second and third cycles is not necessary on intervals that recharge slowly. Field water quality parameters will not be recorded on nitrogen driven wells due to method of collection.

Upon completion of purging, the device will be sampled at the output of the inner sample riser tube. Care will be taken to prevent the sample tubing from coming into contact with the sample containers. All containers shall be filled directly from the sample tube of the Barcads. All QA/QC samples shall be taken in the same manner.

## **4.4 DECONTAMINATION**

### **4.4.1 LOW-FLOW SAMPLING EQUIPMENT**

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by the procedure listed below.

#### *PROCEDURE 1*

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropanol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is flushed out. The outside of the pump and the electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

- Flush the equipment/pump with distilled water

- Flush with non-phosphate detergent solution, such as liquinox. Products such as Decon 90, which contains fluorosurfactants, should not be used. If the solution is recycled, the solution must be changed periodically.
- Flush with distilled water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.
- Flush with PFAS-free water. The final water rinse must not be recycled and must be PFAS-free.

#### **4.4.2 BARCAD SAMPLING EQUIPMENT**

The decontamination of the actuator and outflow tubing will be accomplished through the immersion of the device in the decontamination solutions. All other Barcad equipment is either dedicated to the sample interval, or a non-contact piece of equipment.

- Flush device with distilled water.
- Flush with non-phosphate detergent solution. Products such as Decon 90, which contains fluorosurfactants, should not be used. If the solution is recycled it must be changed periodically or at least once per day.
- Flush with PFAS-free water to remove all of the detergent solution. If the solution is recycled it must be changed periodically or at least once per day.

#### **4.4.4 PFAS SAMPLING CONSIDERATIONS**

Collect groundwater samples for PFAS analyses in accordance with this SOP, SOP SA-1.1, and/or project- or client-specific requirements.

If non-dedicated non-disposable equipment is used between sampling locations, it should be decontaminated with Alconox or Liquinox, unless 1,4-dioxane (a potential component of Liquinox) is also a contaminant of concern. In that case, Liquinox should not be used. Products such as Decon 90, which contains fluorosurfactants, should not be used. Alconox or Liquinox rinses should be followed by a potable water rinse then deionized water rinse. The final decontamination rinse must be with water certified by the laboratory to be PFAS-free.

If sampling for multiple analytes using PFAS-appropriate equipment, collect samples for PFAS analysis last to ensure adequate purging and conditioning of sampling equipment. If practical to do so, suitable PPE (especially gloves) may also be changed out for PFAS sampling. For example, purge and sample a monitoring well for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals using a peristaltic pump with HDPE and silicone tubing, then collect the material for PFAS analysis. If either the proper sampling sequence or proper equipment is unclear, consult the FOL or Tetra Tech PM and record the actual sequence in the field notes.

If sampling wells that have or had dedicated Teflon or FEP tubing that potentially contained PFAS, remove the dedicated tubing and, using silicone or HDPE tubing, remove at least one to two well volumes from the target sampling interval prior to sampling. Accomplish this removal in a manner that is rigorous enough to remove the entire water column from the well and not just a limited vertical interval of the water column. This will minimize the potential for collecting a sample that was in contact with the Teflon/FEP tubing.

The use of detergents must be avoided during decontamination of drilling or other heavy equipment. All equipment must be scrubbed with a plastic brush or steam cleaned with potable water, and rinsed thoroughly in potable water to clean away any debris or material on exposed surfaces.

## **4.5 FIELD QUALITY CONTROL**

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The quality control samples listed in Table 2-5 of the FSP will be collected during groundwater quality sampling activities.

Sampling should proceed from wells with the lowest contaminant concentration to the highest concentration. Collect equipment blanks after sampling contaminated wells and not after sampling background wells. When field duplicate or split samples are to be collected, they will be collected consecutively for the same parameters.



All monitoring instrumentation must be operated in accordance with EPA analytical methods and the operating instructions as supplied by the manufacturer. The instruments must be calibrated at the beginning of each day and the calibration checked at least once throughout the day (i.e. at the end of the day) to verify that the instruments remain in calibration. Temperature measuring equipment, thermometers and thermistors, should be checked for accuracy prior to field use according to the EPA Method 170.1 and the manufacturer's instructions.

#### **4.6 FIELD LOGBOOK**

A field log must be kept each time groundwater monitoring activities are conducted in the field. The field non-weather-proof logbook should document the following:

- Well identification
  - Well depth and measurement technique
- Pre-pumping water level depth, date, time, and measurement technique
- Pumping rate, drawdown, indicator parameter values, and clock time at the appropriate time intervals; calculated or measured total volume pumped
- Well sampling sequence and time of sample collection
- Types of sample bottles used and sample identification numbers
- Preservatives used
- Parameters requested for analysis
- Field observations of sampling event
- Name(s) of sample collector(s)
- Weather conditions

## **STANDARD OPERATING PROCEDURE**

### **9 PACKAGING AND SHIPMENT OF SAMPLES**

## 9 PACKAGING AND SHIPMENT OF SAMPLES

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### 9.1 PURPOSE AND SCOPE

This procedure prescribes the methods for packaging and shipping samples which will minimize the potential for sample loss, spillage or leakage and maintain field sampling compliance with U.S. EPA or U.S. DOT regulations.

The extent and nature of sample packaging will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when all of the following conditions are applicable:

- A. samples are being transported to a laboratory for analyses
- B. samples are being transported to the collector from the laboratory after analyses
- C. samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Qualifications for categories A and B above require that sample collectors comply with U.S. DOT and U.S. Postal Service regulations.

The following information must accompany all samples and will be entered on a sample-specific basis on chain-of-custody records:

- sample collector's name, mailing address and telephone number;
- analytical laboratory's name, mailing address and telephone number;
- quantity of samples;
- date of shipment; and,
- description of sample.

In addition, all samples must be packaged so that they do not leak, spill or vaporize.

## **9.2 GENERAL METHODS**

Place plastic bubble wrap or other cushioning material over the base and bottom corners of each cooler or shipping container as needed to cushion sample containers.

Obtain a chain-of-custody record and enter all the appropriate information as needed or defined by project-specific guidelines. Chain-of-custody records will include complete information for each sample. One or more chain-of-custody records shall be completed for each cooler or shipping container as needed.

Wrap each sample bottle individually as needed and place standing upright on the base of the appropriate cooler, taking care to leave room for packing material and ice or ice substitute.

Place additional packaging material (bubble wrap, vermiculite) throughout the voids between sample containers within each cooler.

Place ice or ice substitutes throughout the cooler or shipping container making sure that any meltwater will be contained.

Add additional bubble wrap or other packing materials to fill the balance of the cooler or shipping container.

Obtain chain-of-custody seals and complete any required information on those seals.

Check that the chain-of-custody forms are complete for each required component and that the indicated bottles are actually in that cooler or shipping container.

If the samples are shipped by air or other public transportation, sign the chain-of-custody form, relinquishing custody of the samples. Relinquishing custody should only be performed when directly transmitting custody to a receiving party or when transmitting to a shipper for subsequent receipt by the analytical laboratory. Shippers should not be asked to sign chain-of-custody records.

Remove the appropriate copy from the chain-of-custody form or make copies as necessary and retain with other field notes. Place the original and remaining copies in a watertight bag and place the bag in the appropriate cooler or shipping container.

Close the cooler or container. Place the chain-of-custody seals over the lid of the container such that it spans the lid and the side it contacts. Transparent tape should be applied over the custody seals. Additional tape should be applied completely around the cooler to secure the lid from accidental opening.

When transporting samples directly to the laboratory by the collecting personnel chain-of-custody will be maintained by the person transporting the samples and custody seals need not be used. Should there be a need to leave samples unattended then chain-of-custody and custody seals will be employed.

If shipment is required, transport the cooler to the shipping terminal or arrange for pickup. Obtain copies of all shipment records as provided by the shipper and retain with other sampling records.

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the custody seal number corresponds with that on the chain-of-custody form. The laboratory should then forward the back copy or a photocopy of the chain-of-custody form to the sample collector to indicate that sample transmittal was complete.

### **9.3 PFAS-SPECIFIC METHODS**

For PFAS sampling, assume that shipping tape used for securing coolers could contain PFAS; therefore, take care not to transfer PFAS from tape to samples.

For PFAS sampling, avoid the use of “Blue Ice” or related items, and only use loose ice placed in double bags. Do not keep PFAS samples in the same cooler as samples for other analytes.

Avoid the use of water-proof field books and “Sharpies” or similar indelible markers when documenting samples.

Sample handling should minimize the PFAS sampling jars from exposure to light and personnel should wash their hands before handling the samples. Personnel should also avoid wearing new (needs to be washed several times without fabric softener) clothing, cosmetics,

shampoos, hair conditioners, moisturizers, hand cream, or other similar personal care products on the day of sample collection or handling.

#### **9.4 DOCUMENTATION**

The documentation for sample packaging and shipping will consist of chain-of-custody records and shipper's records. In addition, a description of sample packaging and shipping procedures will be entered into the field books or any project-specific forms. All documentation will be retained in the project file by the project personnel.